T49/987

Preprint from the 1987

BUREAU OF MINES MINERALS YEARBOOK

Tin

UNITED STATES DEPARTMENT OF THE INTERIOR

The statistical data in this volume represents the most comprehensive, verified, domestic and international coverage for 1987 at the time the volume went to press. More recent information can be found in the monthly Tin Industry Mineral Industry Surveys obtainable from Publications Distribution, Bureau of Mines, Box 18070, Cochrans Mill Road, Pittsburgh, PA 15236.

READEX FICHE best copy available

I 28.37/2:

T 4.9/2:971

UNITED STATES DEPARTMENT OF THE INTERIOR • Donald Paul Hodel, Secretary

BUREAU OF MINES • T S Ary, Director

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

I 28.37/2:

Tin

By James F. Carlin, Jr.[1]

For the seventh consecutive year, there was a world excess of tin. The excess in 1987 was reduced to about one-half from that of 1986, as world mine production stabilized and world consumption increased. Repercussions from the exhaustion of the International Tin Council (ITC) fund to support the tin price in late 1985 continued throughout 1987. Legal actions continued against the London Metal Exchange (LME) and the ITC, brought by tin dealers and banks who had lost money allegedly due to activities of the LME and ITC in late 1985. The price of tin ranged in a narrow band somewhat higher than in 1986, but was still well below the level of recent years. The continuation of relatively low prices led to additional restructuring of tin-mining operations in many producing countries with several mine closures and resultant unemployment.

Table 1.—Salient tin statistics

(Metric tons unless otherwise specified)

	1983	1984	1985	1986	1987
United States:					
Production:					
Mine	W	W	W	W	W
Smelter	2,500	4,000	e3,000	3,213	p3,905
Secondary	14,205	15,417	14,109	r14,850	15,793
Exports[2]	1,340	1,429	1,478	1,547	1,818
Imports for consumption:					
Metal	34,048	41,224	33,830	35,768	41,150
Ore (tin content)	969	3,272	1,616	2,906	2,953
Consumption:					
Primary	34,901	r37,201	r36,524	r33,224	35,597
Secondary	11,246	r11,114	r12,145	r10,198	8,599
Stocks, yearend, U.S. industry	9,859	r9,679	r12,359	r13,957	14,641
Prices, average cents per pound:					
New York market	601.28	567.30	525.90	294.12	309.01
Metals Week composite	654.78	623.80	r595.95	r p303.22	418.78
London	589.19	556.55	r556.26	NA	NA
Kuala Lumpur[4]	590.78	564.95	r540.70	r272.26	368.45
World: Production:					
Mine	r196,942	r198,463	188,635	p179,377	e179,718
Smelter	200,124	r201,555	197,838	p191,403	e189,556

eEstimated. pPreliminary. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; U.S. mine production for 1983-87 was negligible.

[1]Reported figure.

[2]Exports (excluding reexports).

[3]Prices quoted for 10 months only.

[4]Beginning in 1985, Kuala Lumpur replaced Penang as the reference market.

Domestic Data Coverage.—Domestic production data for tin are developed by the Bureau of Mines from a voluntary survey of U.S. mines. Of the four mines to which a survey form was sent, all responded. Domestic production, which was negligible, was withheld to avoid disclosing company proprietary data.

Legislation and Government Programs.—The General Services Administration (GSA) sold 4,080 metric tons of tin in 1987, all of which represented payment material for GSA's Ferroalloy Upgrading Program, which started April 11, 1984.

At yearend, the National Defense Stockpile inventory was 177,053 tons; the stockpile goal was 42,674 tons.

Federal laws provided a depletion allowance of 22% for domestic operations and 14% for U.S. companies producing in other countries.

The U.S. Environmental Protection Agency (EPA) issued a Preliminary Determination on October 7, 1987, to ban all tributyl tin antifouling marine paints that have specified leaching or release rates. The EPA finding carried a 90-day comment period, offering rebuttal from concerned parties.

DOMESTIC PRODUCTION

PRIMARY TIN

Mine Production.—One mine operating in Alaska produced tin concentrates. Domestic mine production data were withheld to avoid disclosing company proprietary data, but total output amounted to only a small fraction of domestic tin requirements.

Smelter Production.—The only domestic tin smelter, Tex Tin Corp., in Texas City, TX, increased tin metal output. The smelter recovered tin primarily from imported and domestic concentrates, as well as some secondary tin-bearing materials, and its own stockpile of tin residues and slags. The smelter's main source of tin concentrates was Peru. The facility also produced a line of solders.

SECONDARY TIN

The United States was believed to be the world's largest producer of secondary tin. Tin metal recovered from tinplate scrap was the only type of secondary tin available as free tin; other secondary tin was available in scrap materials as an alloying ingredient. Secondary tin from recycled fabricated parts was an important source of material for the solder and the brass and bronze industries. The Steel Can Recycling Association in Pittsburgh, PA, funded and operated by five domestic tinplate producers, sought to advance the collection, preparation, and transportation of can scrap.

Table 2.—Secondary tin recovered from scrap processed at detinning and other plants in the United States

		1986	1987
Tinplate scrap treated	metric tons	499,652	506,514
Tin recovered in the form of:			
Metal	do.	1,134	1,151
Compounds (tin content)	do.	W	W
Total	do.	1,134	1,151
Weight of tin compounds produced	do.	W	W
Average quantity of tin recovered per metric ton of tinplate scrap used	kilograms	r2.25	2.23
Average delivered cost of tinplate scrap	per metric ton	$44.76	$44.15

rRevised. W Withheld to avoid disclosing company proprietary data.

Table 3.—Tin recovered from scrap processed in the United States, by form of recovery

(Metric tons unless otherwise specified)

Form of recovery	1986	1987
Tin metal[1]	1,134	1,151
Bronze and brass[2 3]	r8,989	10,982
Lead and tin alloys:		
Antimonial lead	891	622
Babbitt	66	76
Solder	3,978	3,765
Type metal	197	66
Other alloys[3]	17	30
Total	4,947	4,559
Tin content of chemical products	W	W
Grand total	r14,850	15,700
Value (thousands)[4]	$125,461	$145,809

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Includes tin metal recovered at detinning and other plants.
[2]Includes tin recovered from copper, lead, and tin-base scrap.
[3]Includes foil, terne metal, and cable lead.
[4]Based on Metals Week composite price.

Table 4.—U.S. stocks, receipts, and consumption of new and old scrap and tin recovered, by type of scrap

(Metric tons)

Type of scrap	Gross weight of scrap						Tin recovered[2 1]		
	Stocks, Jan. 1	Receipts	Consumption			Stocks, Dec. 31			
			New	Old	Total		New	Old	Total
1986r									
Copper-base scrap	9,489	134,056	10,194	123,086	133,280	10,265	416	4,743	5,159
Brass mills[3]	2,731	7,044	7,017	27	7,044	2,464	224	--	224
Foundries and other plants	3,464	26,221	5,845	17,470	23,315	6,370	274	720	994
Total tin from copper-base scrap	XX	XX	XX	XX	XX	XX	914	5,463	6,377
Lead-base scrap	39,501	778,359	66,024	722,251	788,275	29,585	1,730	5,311	7,041
Tin-base scrap[4]	21	139	W	95	95	65	1,345	87	1,432
Grand total	XX	XX	XX	XX	XX	XX	3,989	10,861	14,850
1987									
Copper-base scrap	10,265	142,137	11,393	131,672	143,065	9,337	475	5,105	5,580
Brass mills[3]	2,464	43,884	43,871	W	43,871	2,894	596	--	596
Foundries and other plants	6,370	26,080	7,568	18,390	25,958	6,492	357	794	1,151
Total tin from copper-base scrap	XX	XX	XX	XX	XX	XX	1,428	5,899	7,327
Lead-base scrap	29,585	893,250	68,586	818,429	887,015	35,820	1,795	5,379	7,174
Tin-base scrap[4]	65	49	W	92	92	22	1,207	85	1,292
Grand total	XX	XX	XX	XX	XX	XX	4,430	11,363	15,793

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data. XX Not applicable.
[1]Tin recovered from new and old copper-base scrap, brass mills, and foundries.
[2]Brass-mill stocks include home scrap, and purchased scrap consumption is assumed equal to receipts; therefore, line does not balance.
[3]Includes tinplate and other scrap recovered at detinning plants; Bureau of Mines not at liberty to publish separately.

CONSUMPTION AND USES

Primary tin consumption increased over that of 1986, mainly owing to gains in tinplate and tin chemicals. Solder was the largest application of primary tin, followed closely by tinplate. Tinplate consumption experienced its first increase in many years as its cost advantage relative to competitive materials for containers became significant, and as tinplate exports surged owing to the lower dollar value.

Tinplate continued to lose markets to aluminum in some container applications. Tinplated steel and tin-free steel accounted for 31% of the 109.2 billion metal cans shipped, and aluminum accounted for 69%. In 1986, when steel accounted for 33% and aluminum for 67%, 104.9 billion metal cans were shipped. Aluminum held an overwhelming segment of the beverage can market, while steel predominated in the food can and the general packaging markets.[2]

Secondary consumption declined as low prices for primary tin made secondary material less attractive.

Table 5.—U.S. consumption of primary and secondary tin

(Metric tons)

	1983	1984[r]	1985[r]	1986[p]	1987
Stocks, Jan. 1[1]	7,549	9,983	8,490	9,336	9,876
Net receipts during year:					
Primary	36,494	38,513	39,906	35,475	38,446
Secondary	5,412	6,110	8,904	11,636	11,707
Scrap	7,435	6,791	7,471	6,346	6,686
Total receipts	49,341	51,714	54,381	53,457	56,789
Total available	56,890	59,777	62,811	62,793	66,664
Tin consumed in manufactured products:					
Primary	34,301	37,201	36,524	33,324	35,597
Secondary	11,246	11,114	12,145	10,196	8,599
Total	45,547	48,315	48,669	43,522	44,196
Intercompany transactions in scrap	245	317	214	354	512
Total processed	45,792	48,632	48,883	43,876	44,708
Stocks, Dec. 31 (total available less total processed)	11,098	11,145	13,928	18,917	21,956

[r]Revised.
[1]Includes tin in transit in the United States.

Table 6.—Tin content of tinplate produced in the United States

Year	Tinplate waste (waste, strips, cobbles, etc., gross weight) (metric tons)	Tinplate (all forms)		
		Gross weight (metric tons)	Tin content[1] (metric tons)	Tin per metric ton of plate (kilograms)
1983	166,186	2,586,810	9,328	3.6
1984[r]	151,540	2,409,299	8,659	3.6
1985	146,041	2,215,042	9,321	4.2
1986[r]	120,186	2,068,246	8,680	4.2
1987	118,870	2,275,984	10,357	4.6

[r]Revised.
[1]Includes small tonnage of secondary tin and tin acquired in chemicals.

Table 7.—U.S. consumption of tin, by finished product

(Metric tons of contained tin)

Product	1986[r]			1987		
	Primary	Secondary	Total	Primary	Secondary	Total
Alloys (miscellaneous)[1]	W	W	W	W	W	W
Babbitt	965	359	1,324	880	210	1,090
Bar tin	449	W	449	708	—	708
Bronze and brass	1,721	1,721	3,502	1,935	1,724	3,659
Chemicals	W	W	W	W	W	W
Collapsible tubes and foil	W	W	W	W	W	W
Solder	11,955	3,855	15,810	10,938	4,912	15,240
Tinning	1,427	W	1,427	1,296	W	1,296
Tinplate[2]	8,880	W	8,880	10,327	W	10,327
Tin powder	1,002	W	1,002	W	W	W
Type metal	W	W	W	W	W	W
White metal[3]	1,057	57	1,134	1,175	W	1,175
Other	6,007	4,197	10,204	8,361	2,343	10,704
Total	33,224	10,198	43,522	35,597	9,090	44,196

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes terne metal.
[2]Includes secondary pig tin and tin acquired in chemicals.
[3]Includes pewter, britannia metal, and jewelers' metal.

Table 8.—U.S. industry yearend tin stocks

(Metric tons)

	1983	1984[r]	1985[r]	1986[r]	1987
Plant raw materials:					
Pig tin:					
Virgin[1]	6,226	5,480	5,712	5,754	6,642
Secondary	722	1,542	2,542	3,021	2,333
In process[2]	692	1,154	1,942	1,377	1,359
Total	7,740	8,176	9,296	10,152	10,365
Additional pig tin:					
Jobbers-importers	668	902	1,642	1,272	1,890
Afloat to United States	1,511	701	1,321	2,433	2,486
Total	2,119	1,503	2,963	3,705	4,376
Grand total	9,859	9,679	12,259	13,857	14,641

[r]Revised.
[1]Includes tin in transit in the United States.
[2]Data represent scrap only, tin content.

PRICES

The price of tin metal, as published in Metals Week, remained in a narrow price band all year, still in a historically low range well below the levels achieved during the past decade.

Table 9.—Monthly composite price of Straits tin for delivery in New York

(Cents per pound)

Month	1986			1987		
	High	Low	Average	High	Low	Average
January	NA	NA	NA	421.82	414.43	418.49
February	NA	NA	NA	422.11	411.89	417.15
March	515.68	392.94	455.79	420.25	409.11	414.01
April	372.20	350.56	364.25	421.17	414.85	418.30
May	363.23	345.22	352.24	423.66	419.43	421.79
June	350.91	343.86	346.61	418.54	408.97	414.49
July	351.53	342.38	346.52	410.52	396.99	403.09
August	351.25	344.14	347.01	421.11	409.35	411.48
September	347.44	343.21	345.53	421.87	418.93	420.73
October	382.68	343.81	353.87	431.49	416.21	424.80
November	395.05	374.16	384.22	438.92	427.37	433.28
December	411.02	393.19	402.77	431.29	425.06	427.77
Average[1]	XX	XX	r [1]383.22	XX	XX	418.78

rRevised. NA Not available. XX Not applicable.
[1]Prices quoted for 10 months only.

Source: Metals Week.

FOREIGN TRADE

Imports for consumption of tin concentrates decreased, indicating the tight supply situation for concentrates worldwide. For many years, there has existed a world excess of tin-smelting capacity compared with tin mine capacity. Imports of tin metal increased, with Brazil remaining the major source by a wide margin, followed by China, Malaysia, Indonesia, and Bolivia. China tripled its imports to the United States compared with those of the prior year. During the year, a trend emerged of foreign producers direct marketing their own refined tin metal to U.S. consumers, thus bypassing the traditional independent broker route. This approach was utilized by producers in Australia, China, and Indonesia. Imports of tin in all forms (ore and concentrate, metal, and waste and scrap) remained free of U.S. duty.

Table 10.—U.S. imports for consumption and exports of miscellaneous tin, tin manufactures, and tin compounds

Year	Miscellaneous tin and tin manufactures				Tin compounds	
	Imports			Exports	Imports	
	Tinfoil, tin powder, flitters, metallics, tin and manufactures, n.s.p.f.	Dross, skimmings, scrap, residues, tin alloys, n.s.p.f.		Tin scrap and other tin-bearing material, except tinplate scrap	Quantity (metric tons)	Value (thousands)
	Value (thousands)	Quantity (metric tons)	Value (thousands)	Value (thousands)		
1985	$3,290	877	$2,804	$18,357	827	$5,164
1986	1,280	1,121	1,899	19,843	860	5,165
1987	1,854	2,270	9,241	13,549	838	5,162

Source: Bureau of the Census.

Table 11.—U.S. exports and imports for consumption of tin, tinplate, and terneplate in various forms; exports of ingots, pigs, bars; imports of tinplate scrap

Year	Ingots, pigs, bars		Tinplate and terneplate				Tinplate scrap	
	Exports		Exports[1]		Imports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
1985	1,478	$13,744	155,119	$85,600	281,137	$222,504	3,815	$441
1986	1,547	9,742	219,074	91,793	344,973	199,484	2,375	342
1987	1,818	9,456	209,526	106,156	329,783	193,110	2,543	390

[1]Tinplate circles, strips, and cobbles are included with exports of tinplate and terneplate.

Source: Bureau of the Census.

Table 12.—U.S. imports for consumption of tin, by country

Country	1986		1987	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Concentrates (tin content):				
Bolivia	259	$2,344	732	$1,755
Canada	1	1	--	--
Peru	3,676	11,348	2,165	7,596
Zaire	--	--	56	158
Total	3,936	13,693	2,953	9,509
Metal:[2]				
Austria	--	--	60	389
Australia	94	691	1,406	9,596
Belgium	--	--	302	2,005
Belize	99	505	--	--
Bolivia	4,893	28,943	3,476	10,579
Brazil	9,456	62,334	13,089	87,306
British Indian Ocean Territory	--	--	20	136
Burma	--	--	20	119
Canada	32	282	43	197
Chile	1,776	11,291	39	118
China	2,955	19,681	8,044	52,152
Denmark	--	--	90	609
France	35	190	40	267
Germany, Federal Republic of	18	62	(3)	4
Greece	--	--	3	3
Hong Kong	422	2,593	714	4,227
India	850	6,006	220	1,432
Indonesia	4,149	27,973	4,001	27,339
Iran	60	365	--	--
Israel	2	20	--	--
Italy	75	630	--	--
Japan	100	651	60	394
Korea, Republic of	--	--	1	5
Malaysia	6,230	44,221	4,959	32,499
Mexico	432	2,075	727	5,018
Netherlands	471	2,578	379	2,555
Nigeria	--	--	79	527
Seychelles	--	--	20	41
Singapore	691	5,163	743	5,036
Somalia	--	--	122	799
South Africa, Republic of	35	332	--	--
Switzerland	--	--	490	3,234
Taiwan	135	851	--	--
Thailand	1,901	13,965	1,460	9,452
United Arab Emirates	--	--	40	257
United Kingdom	730	4,363	467	3,178
Zaire	5	38	--	--
Zimbabwe	123	669	35	226
Total[3]	35,768	235,506	41,150	259,699

[1]Bars, blocks, pigs, or granulated.
[2]Less than 1/2 unit.
[3]Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

WORLD REVIEW

The Sixth International Tin Agreement, which commenced on July 1, 1982, continued in effect throughout 1987, although its operations were restricted. Many high-level permanent employees of the ITC departed during the year and only a skeletal staff remained. The United States was not a member of the agreement.

Legal actions continued to be conducted on behalf of tin dealers and banks that had lost money, allegedly owing to activities of the LME and the ITC in late 1985, as the ITC utilized borrowed funds to support the tin price.

The Association of Tin Producing Countries (ATPC), comprising seven major producer nations—Australia, Bolivia, Indonesia, Malaysia, Nigeria, Thailand, and Zaire—completed its fourth year as an organization. ATPC viewed itself as being complementary to, and supportive of, the activities of the ITC, and the organization continued to persuade its member countries to restrain tin production and exports until a world supply-demand equilibrium was achieved. Industry sources estimated the world tin surplus at about 40,000 tons at yearend 1987.

Australia.—The Renison Bell Mine in Tasmania, owned by Renison Consolidated Goldfields Ltd., increased tin output and accounted for an estimated 90% of Australia's tin mine production as numerous smaller tin mines closed during the year due to the relatively low tin price. The Renison Mine was the world's largest hard-rock underground tin mine and was a relatively low-cost producer with substantial high-grade reserves. Renison operated at its full capacity of 850,000 tons of tin ore throughput. The entire tin concentrate output from Renison was reportedly toll smelted in Malaysia. During 1987, Renison commenced a program of direct sales of most of its refined tin metal to user firms in industrialized countries, including large tonnages to U.S. companies.

Greenbushes Ltd. continued to mine tin and tantalum, with throughput increasing to 1.4 million tons of ore. Tin output declined to 400 tons, and the overall operating rate was 40% below capacity. The firm expected improved tantalum prices in 1988 and planned to recommission its tailings retreatment plant, which would increase tin and tantalum concentrate production.

Great Northern Mining Corp. Ltd. ceased tin production in mid-1987, placing its Jumna mill near Irvinebank, Queensland, on care and maintenance until tin prices improved. During 1987, the firm produced 308 tons of tin-in-concentrate.

The Tolltreck Metal Products Ltd. tin smelter in Sydney and the Greenbushes tin smelter, at their tin-tantalum mine near Bunbury, reduced smelting operations to a part-time basis due to shortages of concentrates.

Kokan Mining Co. Ltd., a subsidiary of Nippon Kokan K.K. of Japan, and Greenbushes Tin Ltd. of Australia announced plans for a joint venture to mine tin and tantalum ore in the Pilbara mining district of Western Australia beginning in 1988. The deposits were about 200 kilometers south of Port Hedland.

Bolivia.—The Bolivian tin-mining industry continued the substantial down-sizing and restructuring that had started in 1985. Despite this, all production units within state-owned Corporacion Minera de Bolivia (COMIBOL), the country's largest tin producer, were reportedly unprofitable. COMIBOL was authorized to lease some of its mining properties to cooperatives formed by former workers. To operate the properties, the cooperatives must pay COMIBOL a minimum rent of 1% of the net value of mineral production. Under consideration for these leases were the Catavi, Colquiri, Colquechaca, Japo, Santa Fe, Morococala, and Viloco tin mines, and the Machacamarca tin processing plant. Reportedly, in 1987, COMIBOL's production was limited to two tin mines at Viloco and Caracoles.

Brazil.—Brazil was not a member of the ATPC but agreed to cooperate with its guidelines and restrict its exports of tin to 21,000 tons during 1987. Brazil ranked as the world's second largest tin producer. Tin mine and smelter production was primarily owned by private enterprise, domestic and foreign. Brazilian tin mines generally were considered to be the lowest cost tin mines in the world.

The leading producer, Paranapanema, accounted for more than one-half of Brazil's total tin output, operating at least seven tin mines. The Pitinga Mine, about 300 kilometers northeast of Manaus in Amazonas State, was the firm's largest mine, and occupied an area of 250 square kilometers.

Pitinga's reserves were reportedly 220,000 tons of contained tin in high-grade ore. In addition to cassiterite, other valuable minerals such as columbite-tantalite and zirconite were reportedly present but not currently mined.

Brascan Recursos Naturais S.A. (BRN), jointly owned by Brascan Ltd. and BP Mineração, was Brazil's second leading tin producer. It operated several mines, all in the State of Rondônia. BRN's tin concentrates were shipped to its Cesbra smelter for refining.

Brumadinho, the third largest tin producer, operated alluvial tin mines in Rondônia and continued to explore tin properties in Goiás State. Brumadinho transported all its tin concentrates to the tin smelter of Bera do Brasil S.A., near São Paulo. Bera was 70% owned by Brumadinho and 30% by Paul Bergsoe and Son A/S of Denmark.

Rhodia, the Brazilian subsidiary of Rhône Poulenc S.A. (France), acquired the Mineração São Francisco de Assis tin mine from St. Joe Minerals Corp. for about $7 million.

There were reports of a major new tin ore-body discovery in the Rondônia region. Deposits reportedly contained between 10,000 and 100,000 tons of tin and were in the Alto Paraiso area.

Canada.—The East Kemptville Tin Corp. Ltd. continued tin mining operations at its open pit mine at East Kemptville, Nova Scotia. The firm was owned by a consortium of United States and Canadian banks, with mine operations handled by Rio Algom Ltd., the prior owner. The mine was reported to contain 41 million tons of high-grade ore and 15 million tons of low-grade ore, with an average grade of 0.16% tin. At full capacity, the mill throughput of 9,000 tons daily was projected to yield about 4,800 tons annually of tin-in-concentrate as well as some copper and zinc. During 1987, the mine operated at substantially less than full capacity, the recovery rate was about 63%, and the mine was reportedly profitable. Most of the output of the mine was shipped to the Capper Pass Ltd. tin smelter in North Ferriby, United Kingdom.

China.—Tin resources were concentrated in the southern region, especially in Guangdong, Guangxi, Hunan, Jiangxi, and Yunnan Provinces. The country's largest tin producer is Yunnan Tin Corp., followed by DaChang Tin Mining Bureau in Guangxi. The combined annual output of these two accounted for about 60% of China's production of tin concentrates. In 1987, China reportedly exported about 10,000 tons of refined tin, most of which was shipped to the United States.

India.—Sartin Ltd. announced plans to construct a 300-ton-per-year tin smelter at Chowdwar with the aid of Base Synergy Associates Ltd. (United Kingdom). The new smelter was expected to use domestic tin concentrates from the Koraput District in India as well as imported tin concentrates.

Indonesia.—Tin mining was mostly performed at offshore sites in Indonesia, which is one of the few countries to increase tin mine output in recent years. P.T. Tambang Timah (P.T. Timah), the state-owned mining firm, was the major producer. This firm raised tin production in 1987, accounting for 80% of Indonesia's tin output. P.T. Timah was the world's largest tin-mining company, producing an estimated 22,000 tons annually from 247 mines and 29 dredges.

P.T. Koba Tin was the second largest producer and was jointly owned by Kajaura Mining Corp. (Pty.) Ltd., Australia, and P.T. Timah. Koba closed its Bangka Island tin mining operation. Unlike most major world tin producers, who sell their tin in the United States through independent brokers, Indonesia has for many years sold its tin directly to U.S. users through its own agency.

Malaysia.—Although Malaysia remained the world's leading tin producer, its tin industry continued to restructure. The largest producing firm, Malaysia Mining Corp., undertook a program of either disposing of or reducing its holdings in tin mines that had limited tin reserves. Among those affected were Aokan Tin Dredging, Ayer Hitam Tin Dredging, Kampong Lanjut Tin Dredging, Kamunting Tin Dredging, Tongkah Harbour Tin Dredging, and Tronoh Mines.

Two large tin smelters in Penang, one owned by Datuk Keramat and the other owned by Malaysia Smelting Corp., operated at about 80% capacity. Both smelters operated increasingly on a toll-smelting basis, handling tin concentrates from Australia, Bolivia, and China, because the tin mine output from Malaysia has generally decreased in recent years.

Mexico.—Tin mining occurred in the three adjoining States of Durango, Zacatecas, and San Luis Potosí in north-central Mexico. The country's major tin mine, the El Perro Mine, in San Luis Potosí, was owned by Cia. Minera Pizzuto.

Estãno Electro S.A. de C.V. operated a tin

smelter at Tlalnepantla, near Mexico City. Fundidora de Estãno S.A. operated a tin smelter at San Luis Potosí. Metales Potosí S.A. ran a smelter in San Luis Potosí as did Minera de Rio S.A. All four smelters mainly treated imported tin concentrates.

Namibia.—The Uis Mine in the Brandberg area produced most of the country's tin. The Uis Mine was owned by Industrial Minerals Mining Corp. (Pty.) Ltd., a wholly owned subsidiary of South African Iron and Steel Industrial Corp. Ltd. (Iscor). The Uis tin deposits occurred as low-grade 0.11% to 0.15% tin cassiterite mineralization. The tin concentrates were shipped directly to the Vanderbijlpark steelworks in the Republic of South Africa, where they provided a large part of Iscor's tin for use in making electrolytic tinplate.

Nigeria.—The five tin-mining companies were Amalgamated Tin Mines of Nigeria (Holdings) Ltd., Bisichi-Jantar Nigeria Ltd., Kaduna Prospecting Nigeria Ltd., Ex-Lands Nigeria Ltd., and Gold & Base Metal Mines of Nigeria Ltd. All tin concentrates were smelted domestically by Makeri Smelting Co. Ltd. at Jos in Plateau State.

Peru.—The sole tin mine was the San Rafael Mine owned by Minsur S.A. near Juliaca. The mine was within the northern extension of the Bolivian tin belt. Tin grades averaged 1.8%. Peru was the main supplier of tin concentrate to the United States.

Minsur announced plans to construct a $10 million tin smelter at Pisco. A new organization, Funsur, was to be formed to build the smelter, with partial funding through Government incentives. Plant construction was expected to start in early 1988, with a 2-year completion goal.

South Africa, Republic of.—Gold Fields of South Africa Ltd. was the parent firm of two moderate-sized tin producers, Rooiberg Tin Ltd. and Union Tin Mines Ltd. Zaaiplaats Tin Mining Co. Ltd. was also a producer.

Spain.—The country's two remaining tin mines announced permanent closure as a result of low tin prices. Minera Adelaide S.A. closed its La Parilla tin-tungsten mine near Caceres after it encountered flooding problems. Minas de San Finx S.A., near La Coruna, also stopped production.

Thailand.—Some major tin-mining firms that had suspended production in 1986 resumed activity. Dutch Chemical Products Holdings Ltd. acquired a 76% interest in the dormant Thai Pioneer Enterprise smelter. The 3,600-ton-per-year tin smelter had been closed since 1982, but there were plans to reopen it by 1988. The smelter was expected to secure tin concentrates from miners in central and northern Thailand.

The Thai Tinplate Manufacturing Co. announced plans to increase its capacity to 270,000 tons annually of tinplate. In 1987, Thailand was a net tinplate importer.

U.S.S.R.—Although the U.S.S.R. ranked as the world's fourth leading producer of tin ore, it was reportedly a net importer of tin metal. Tin mining was centered in the far eastern regions of the country where tin-mining and beneficiation capacities were being expanded. A new automated production line to extract tin from lean ore was commissioned at the Khingan tin complex in the Birobidzhan Autonomous Oblast' in the Soviet Far East. Output at Khingan was expected to double by 2000. Expansion continued at the Deputatskiy tin-mining and beneficiation complex in Yakutia, with a new tin concentrator reportedly near completion. The planned second-stage expansion of Deputatskiy, scheduled for 1995, would increase tin production to the level where the U.S.S.R. would no longer need to import tin. The country imported about 35% of its tin requirements in 1987.

United Kingdom.—Carnon Consolidated Tin Mines Ltd. continued operations, with Government aid to its two tin mines in Cornwall. Operating costs were reduced by selective mining of rich and easily accessible veins, postponement of long-term development projects, staff cutbacks, and a wage freeze. Significant mine and mill improvements were made, especially at South Crofty Mines, where refurbishment of the hoisting shaft more than doubled ore-hoisting capacity. About one-half of Carnon's tin concentrates was sent to Rio Tinto-Zinc Corp. PLC's Capper Pass tin smelter, and the remainder was refined in Europe. The Capper Pass smelter depended on imports, mostly from South America, for most of its feed stock.

Geevor Tin Mines PLC stopped tin mining at midyear after hoisting 40,000 tons of tin ore during the first 6 months at its Pendarves Mine.

Zaire.—The major tin producer was Société Minière et Industrielle de Kivu (Sominki) in Kivu. The firm was 28% Government-owned and 72% owned by Empain-Schneider Group of France. Tin concentrates were shipped to Europe for smelting. The second largest producer was Société Zairetain, with 50% Government ownership and 50% ownership by Geomines Cie. of Belgium.

Table 13.—Tin: World mine production, by country[1]

(Metric tons)

Country	1983	1984	1985	1986[p]	1987[e]
Argentina	291	274	451	379	300
Australia	[e]9,275	7,923	6,374	8,470	9,000
Bolivia	25,278	19,911	16,186	10,479	7,000
Brazil	13,275	19,957	26,514	25,260	[e]30,900
Burma	1,642	2,028	1,751	1,495	[e]900
Cameroon	[e]10	14	9	9	9
Canada	141	217	120	[e]2,450	3,390
China[e]	14,000	15,000	15,000	15,000	15,000
Czechoslovakia[e]	250	250	250	250	250
German Democratic Republic[e]	1,800	1,800	1,800	1,600	1,600
Indonesia	26,553	23,233	21,709	24,040	[e]27,000
Japan	600	485	510	500	[e]86
Korea, Republic of	--	19	21	1	5
Laos	359	450	[e]540	[e]550	550
Malaysia	41,367	41,307	36,884	29,135	[e]30,388
Mexico	[r]334	416	580	585	[e]372
Namibia	[e]1,400	906	984	710	600
Niger	40	76	[e]100	[e]90	110
Nigeria	1,560	1,700	[e]950	[e]1,090	1,100
Peru	2,808	3,314	3,770	4,817	5,000
Portugal	347	[e]300	[e]200	[e]100	100
Rwanda	1,053	1,093	813	29	--
South Africa, Republic of	2,668	2,301	2,153	2,054	[e]1,413
Spain	444	438	657	[e]400	400
Swaziland	5	1	--	--	--
Tanzania	[r]6	[e]4	2	[r e]2	2
Thailand	19,943	[r]21,960	16,864	17,066	[e]15,008
Uganda	18	[e]18	[e]18	[e]18	10
U.S.S.R.[e]	22,000	23,000	23,000	23,500	24,000
United Kingdom	4,625	5,216	5,204	4,276	4,000
United States	W	W	W	W	W
Vietnam[e]	550	500	500	550	620
Zaire[4]	2,163	2,708	3,100	[e]2,800	1,500
Zambia	[e]22	4	22	3	3
Zimbabwe[e]	1,700	1,670	1,670	1,650	1,600
Total	[r]196,942	[r]198,463	188,635	179,377	179,713

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total."

[1]Contained tin basis. Data derived in part from the Monthly Statistical Bulletin of the International Tin Council, London. Table includes data available through June 17, 1988.

[2]Excludes tin content of copper-tin concentrates.

[3]Reported figure.

[4]Nonduplicated total of content of concentrates plus smelter production.

Table 14.—Tin: World smelter production, by country[1]

(Metric tons)

Country	1983	1984	1985	1986[p]	1987[e]
Argentina[2]	254	292	135	365	350
Australia	2,913	2,899	2,683	1,199	600
Bolivia	14,164	15,842	12,859	7,673	2,800
Brazil	12,950	18,887	24,701	24,427	25,400
China[e]	15,000	15,000	15,000	15,000	15,000
Czechoslovakia[2]	397	425	[e]430	[e]430	430
German Democratic Republic[e]	2,000	2,000	2,200	1,600	1,800
Germany, Federal Republic of[e]	[3]417	417	400	350	300
Indonesia	28,390	22,467	20,909	22,080	[e]23,800
Japan	1,260	1,354	1,291	1,280	[3]895
Malaysia[4]	53,328	46,911	45,500	43,788	45,000
Mexico[3]	1,216	1,531	1,492	[e]1,500	1,500
Netherlands	5,398	6,517	6,033	[e]5,000	5,000
Nigeria	1,190	1,400	1,020	[e]1,000	1,000
Portugal	443	422	408	199	130
Rwanda	1,110	[e]1,000	[e]800	--	--
South Africa, Republic of	2,685	1,592	2,069	2,001	[3]1,479
Spain	3,700	4,400	3,900	[e]3,500	3,600
Thailand	18,467	19,729	17,996	19,672	15,300
U.S.S.R.[e]	24,000	[r]25,500	[r]25,500	26,000	26,500
United Kingdom	6,467	7,105	7,548	9,227	12,300

See footnotes at end of table.

Table 14.—Tin: World smelter production, by country[1] —Continued

(Metric tons)

Country	1983	1984	1985	1986[p]	1987[e]
United States[2]	2,500	4,000	[r]3,000	3,213	[3]3,927
Vietnam[e]	[3]520	475	570	[r]620	645
Zaire	201	170	85	([r])	
Zimbabwe	1,234	1,210	1,297	1,079	1,100
Total	200,124	[r]201,555	197,836	191,403	189,556

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Data derived in part from the Monthly Statistical Bulletin of the International Tin Council, London. Output reported throughout is primary tin only unless otherwise specified. Table includes data available through June 17, 1988.

[2]May include secondary tin.

[3]Reported figure.

[4]Includes small production of tin from smelter in Singapore.

[5]Primarily from imported tin concentrate.

[6]Includes tin content of alloys made directly from ores.

[7]Revised to zero.

TECHNOLOGY

A variety of tin chemical formulations were developed to meet specific requirements in several markets for heat stabilizers. In the market for vinyl siding and window profiles, the Carstab Div. of Morton Thiokol Corp. developed a new compound class, which can be used with organotin mercaptides reportedly to provide excellent processing latitude and superior weathering in earthtone colors. Ciba-Geigy developed a maleate-free tin carboxylate for use in noncoated vinyl siding, with superior weathering reported. The Argus Div. of Witco Corp. developed a low-sulfur butyltin which reportedly improved heat stability and chalking resistance. The Interstab Div. of Akzo Chemie America Co. introduced an estertin-based product with reportedly superior color-retaining properties for the home window frame field. In the market for polyvinyl chloride bottles, Rhone-Poulenc developed a beta diketone for a taste and odor-sensitive application for clear water bottles. M&T Chemical Corp. introduced a new octyl tin liquid for food bottles. In the market for piping, Interstab developed an estertin-based liquid, reportedly offering good whiteness properties.[3]

Weirton Steel Corp. announced development of an easy-open end for steel cans. Although adaptable to both three-piece and two-piece food cans, plans were to use the new ends initially on three-piece containers. Typical applications would be for packaging fruits, vegetables, dry products, and pet foods.[4]

Metal Box Engineering Corp. Ltd. in the United Kingdom, developed a new automated spin-necking and pre-spin-necking technique for tinplate cans. This process reportedly saves considerable material in the can-making process and thus offers cost reductions and a lighter weight can, two factors that could enable tinplate to increase its share of the beverage can market.[5]

Selective Electronic Inc. developed Laser Pour, a new mold-level-control system for tin and related alloy casting shapes. The closed-loop system was constructed around a laser level sensor and was claimed to offer total system control resulting in maximum casting quality and efficiency. The unit could provide high-quality and lower cost castings of tin and its alloys.[6]

Solarex Corp. announced development of a thin-film, amorphous silicon solar cell deposited on glass coated with a proprietary, textured tin oxide. The solar cell has a conversion efficiency of 11.9%, reportedly the highest efficiency achieved for a single-junction, thin-film solar cell. With further development, the cell could find application in commercial solar cells.[7]

Several firms announced introduction of new tin solders to meet the market needs for the plumbing industry. The recently amended Safe Drinking Water Act prohibited the use of lead in solders in municipal drinking water systems; consequently, solder makers developed alternative solders. Some typical new solders developed for this market were 95% tin, 5% antimony; and 95% tin, 5% silver.

---

[1]Physical scientist, Branch of Nonferrous Metals.

[2]Can Manufacturer's Institute. Metal Can Shipments Report 1987. Washington, DC, 1987, p. 5.

[3]Modern Plastics. V. 64, No. 9, Sept. 1987, pp. 70-71.

[4]Iron and Steel Engineer. V. 65, No. 9, Sept. 1987, p. 44.

[5]Canning International. V. 2, No. 2, May 1987, pp. 21-22.

[6]Tin International. V. 60, No. 6, June 1987, p. 125.

[7]Chemical & Engineering News. V. 65, No. 21, May 25, 1987, p. 19.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1988— 242-377/80041